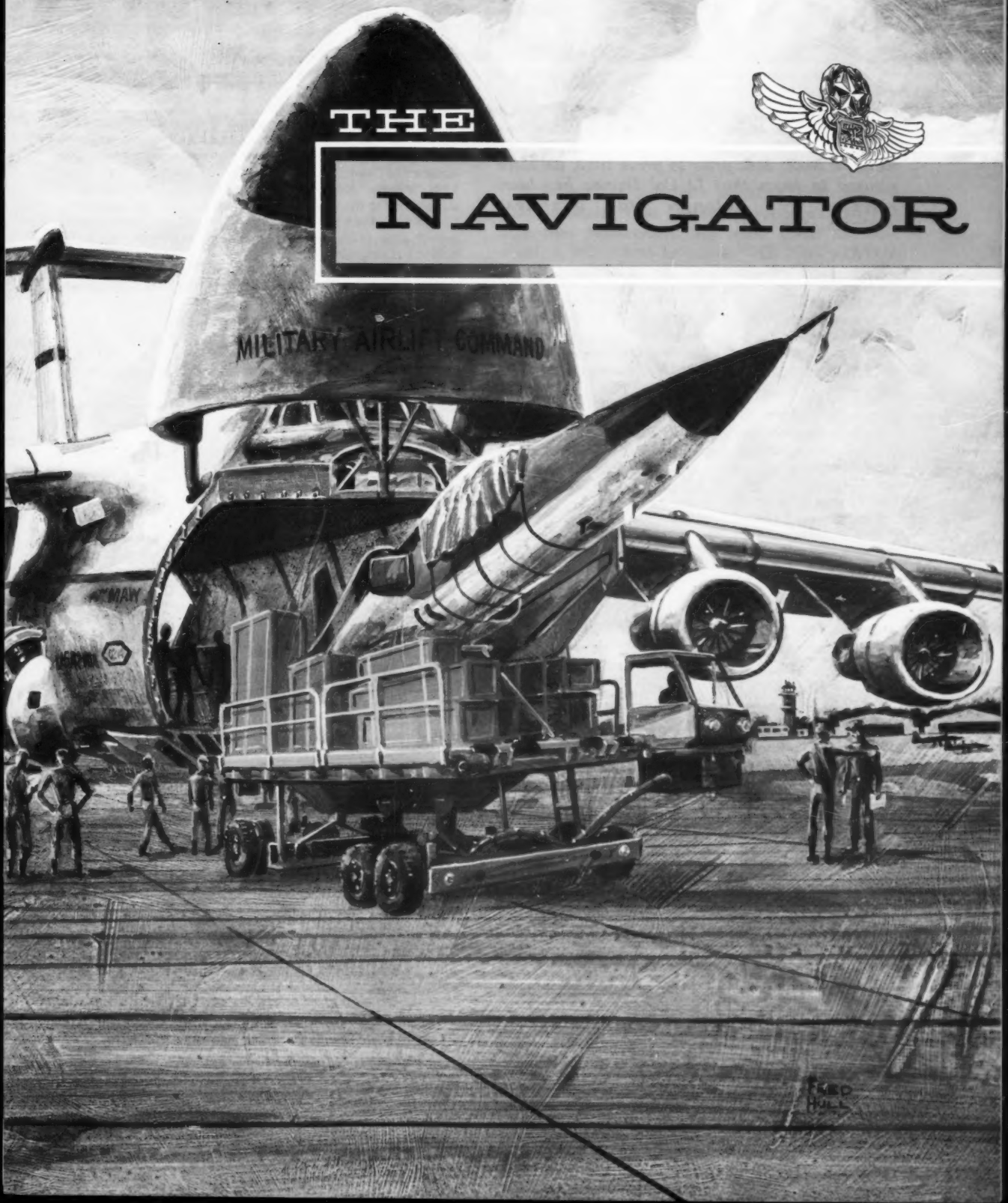
AFRP 50-3, Volume XXIX, Number 2, Summer 1982

THE NAVIGATOR



NAVS OF NOTE

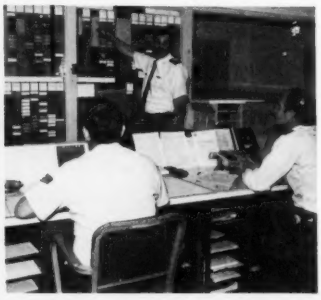
LIEUTENANT COLONEL CHARLES J. DUMAS

Editor's Note: Just prior to press time, we were pleased to learn that Lt Col Dumas has been selected for colonel. Our heartiest congratulations!

When Lieutenant Colonel Charles J. Dumas assumed command of the 3d Military Airlift Squadron on June 15, 1981, he established another "first" in the Military Airlift Command and the United States Air Force. Previously, he was the first navigator Operations Officer of a C-5 squadron, and now he is the first to command a C-5 squadron. "Becoming Commander of the 3d Military Airlift Squadron was the proudest moment of my life—a dream come true. After the change to Title 10, I considered commanding a flying squadron but never thought the opportunity would present itself."

The 3d Military Airlift Squadron, Dover AFB, Delaware, flies the C-5 Galaxy, the world's largest aircraft, on strategic airlift missions around the globe. It is one of four C-5 airlift squadrons in the Air Force and represents 12.5 percent of the Department of Defense total airlift capability.

Graduating from Northwestern Louisiana State University with a degree in Electronics Technology, Colonel Dumas was commissioned through OTS in 1962. His first assignment after Avionics Maintenance School was to Kindley AFB, Bermuda, as a maintenance supervisor with the 53d Weather Reconnaissance Squadron. He next served as a maintenance officer at Goodfellow AFB, Texas.



In 1967, Colonel Dumas entered Undergraduate Navigator Training at Mather AFB, California. Upon earning his wings, he exchanged his maintenance wrench for a sextant and was assigned to Charleston AFB, South Carolina, flying C-124s in the 17th Military Airlift Squadron. Eventually, the squadron transitioned to the C-141 Starlifter and was redesignated as the 41st Military Airlift Squadron. Shortly thereafter, he picked up his wrench again to become maintenance supervisor with the 437th Avionics Maintenance Squadron.

In 1970, Colonel Dumas dusted off his sextant and headed for a SEA tour, flying AC-130 "Spectre" gunships at Ubon RTAB, Thailand with the 16th Special Operations Squadron. "Flying gunships was a unique experience. I wouldn't take a million dollars for it, but I also wouldn't want to do it again."

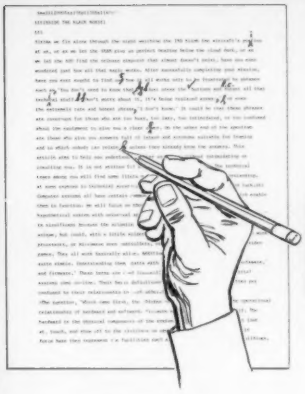
After returning from SEA, Colonel Dumas was assigned to Dover AFB, as a navigator with the 9th Military Airlift Squadron. He participated in the squadron's transition from C-141s to the C-5 Galaxy. The years of bending a wrench paid off when he was selected as Commander of the 436th Avionics Maintenance Squadron (AMS). "Becoming a commander was an exhilarating yet different experience. Suddenly I not only had the mission to worry about, but people problems to deal with too." Four successful years as the AMS commander led to another squadron commander's job with the 374th Organizational Maintenance Squadron at Clark AB, Philippines.

Back at Dover AFB in 1979, Colonel Dumas took the reins of the 436th Airlift Control Element (ALCE). "Younger officers have asked for my key to success. Honestly, I think I have been very fortunate to have had good jobs and to have worked for bosses who let me have the freedom to do the job my way. As a maintenance squadron commander, the experience I gained from dealing with a grand mixture of people really helped. However, when I look back over my career, being Commander of the ALCE gave me the most flexibility to operate and grow as a commander. I have always considered myself an officer first and then a navigator, maintenance chief, or whatever title I had. Once you are given the opportunity to command and do a good job, it leads to other positions of greater responsibility. In retrospect, my formula for success is being persistent and aggressive in seeking new challenges, and then doing my best in any job assigned."

Apparently Colonel Dumas' formula has worked because, after the ALCE job, he became the 436th Military Airlift Wing's Chief of Combat Operations. Then, in 1980, he made history by becoming the first navigator to serve as the Operations Officer of a C-5 operational squadron. It was a natural step when he was elevated to his present position as Commander of the 3d Military Airlift Squadron.

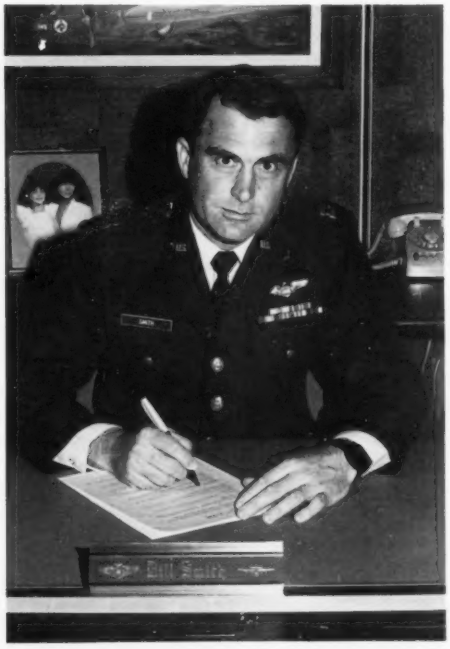
When asked about the complexity of being a C-5 squadron commander, Colonel Dumas' philosophy is quite basic. "Most people want to do a good job, but they must know what you want and you must let them do it on their own. Every officer and NCO has the potential to manage, but to lead takes a lot more. Leadership is what really makes things happen. Leaders are not created in the classroom; only the principles are learned there. It's up to the individual to take the first step and make things happen."

(continued on page 17)



FROM THE EDITOR

MEET YOUR NEW EDITOR: *Captain William C. Smith is a 1969 graduate of the State University of New York at Plattsburgh and a 1980 graduate of Pepperdine University. Commissioned through OTS, he completed UNT in December 1974. Initially assigned to the 32 TAS, Little Rock AFB, Arkansas, Captain Smith spent two years flying C-130s in the tactical airlift mission. In 1977, he was reassigned to the 6594 Test Group, Hickam AFB, Hawaii as a JC-130 Aerial Recovery Navigator. With a transfer to Mather AFB in 1980, Captain Smith served as a UNT instructor with the 452 FTS until assuming his present duties. He is a senior navigator with 1,900 flying hours.*



It is with tremendous pleasure, anticipation, and optimism that I assume duties as editor of this fine publication. My main goals are two. First, I will strive to make THE NAVIGATOR more responsive to your wishes and needs. Second, I will endeavor to maintain the magazine's tradition of excellence.

We are immeshed in a period of increasing scrutiny and cost evaluation. Such conditions require improved efficiency and quality. For us, the emphasis to reduce cost is evidenced by the change in paper stock of this very issue of our publication. We are asked to do more with less whether our mission is to inform or defend. Rather than be frustrated by new constraints, let's accept them as a challenge to strengthen our determination and professional spirit.

This issue of THE NAVIGATOR contains many excellent articles written by "those who are doing." There is a fine account of the work being done worldwide by our C-5 strategic airlift crews. In an enlightening interview, Major General Irwin P. Graham offers some career guidance, along with recollections of his operational experiences. For those eager to learn new navigational techniques, we feature interesting twists on radar and celestial methods.

The magazine relies upon your contributions. I encourage all of you to continue supporting us with accounts of your operational experiences, special missions, military exercises, or personal techniques. All subjects related to navigation or professional development are fitting manuscript topics.

I sincerely hope that you are pleased with this issue and I welcome your feedback. Please write to us with your comments and ideas. Above all, we wish that you remain loyal readers.

William C. Smith

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Department of the Air Force

THE NAVIGATOR

Proudly Serving Air Force Navigators Around the World Since 1953

SECRETARY OF THE AIR FORCE
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GEN THOMAS M. RYAN, JR.

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Our cover depicts the strategic airlift role of the C-5A. The navigator plays an important part in that role, as you may read on the following page.

Have you wondered how the early seafarers determined their positions? Their tricks can work for you. Read "Longitude by Visual Observation" on page 23.

Distribution: One copy per two navigators.

the C-5A

Captain Kimberly H. GILBERT
3 MAS
Dover AFB, DE

As a C-5 navigator stationed at Dover AFB and a veteran at representing the red, white and blue in some 20 countries all over the globe, I feel a certain pride in contributing to the Air Force image.

With the advent of the triple inertial system (INS) in the C-5, some may believe the navigator is in danger of becoming a has-been. As recently as a year ago, C-5 navigators were working much more with such basics as Doppler, Loran and celestial to maintain course tolerances. Despite the accuracy of the new INS system, the navigator still plays an indispensable role in verifying point programming, system accuracy, and detecting malfunctions. (Believe it or not, even triple INS inadvertently wanders off course on occasion.)

Precise navigation becomes particularly critical during approaches into airfields near mountains and borders of unfriendly countries within high density traffic areas. Since these hazards are inherent with most of our overseas destinations, the INS computer position must be checked and often updated for positive aircraft positioning.

Most of our regular runs are to Rhein Main and Ramstein, Germany, as well as Torrejon, Spain. Intra-theater hops include locations typically in the Middle East, Turkey and England. Occasionally we navigate on out-of-the-ordinary missions such as through the Berlin Corridor or to Amsterdam, but these are few and far between. More often we're tasked with exercise support. In November and December 1981, C-5s flew some 35 missions into and out of northern Africa in support of Exercise Bright Star 82.

Some of our trips require rendezvous with tankers. We've navigated and conducted radar rendezvous on several missions non-stop from the East Coast to the Middle East, thanks to a fuel onload from KC-135s or KC-10s. Mission success hinges on the navigator's fuel planning and precise radar work to set up a rendezvous.

Our Travis counterparts may not agree, but our most sought after "over-the-rainbow" trips are the infrequent missions to the Orient, which average three or four a year for the Wing. The following is an account of a special airlift mission to Thailand.

Despite a noticeable shift of operational emphasis to the Middle East in recent years, Southeast Asian nations continue to look to the U.S. for military support. Because of its common borders with Communist Laos and Kampuchea (formally Cambodia), Thailand has become one of

NON-STOP 8,000 Mile Route

the most critical pro-Western nations in the region. Out of this and other factors was born an agreement to ship eight F-5 fighters in a single C-5 nonstop from California to Bangkok. The 20-hour enroute time would entail two separate rendezvous and aerial refuelings with four tankers, for a total onload of 160,000 pounds of fuel.

Navigator planning began several days in advance with preliminary fuel, route and rendezvous planning from advance message traffic. All the basic nuts and bolts were to be in place well ahead of time to facilitate any last minute changes or contingencies.

On the first day of the mission, the crew and plane got off on the right foot by scoring an on-time departure. The two navigators reviewed overall procedures in flight, monitored progress and helped ensure safety during the approach into McClellan AFB preparing for the onload of the F-5 payload.

The next leg was the biggie. With a 764,000 pound gross weight takeoff, we departed on our marathon journey. We were to traverse 8,000 miles nonstop, a third of the way around the world.

A variety of INS, radar or weather problems could obstruct the successful aerial refuelings required if the mission were to have the important impact of an on-time arrival. Luck was with us on the first rendezvous as the refueling took place without a hitch just south of the Aleutian Islands, with a midnight dawn highlighting successful completion. The second refueling took place over Kadena AB, Okinawa. Finally, the navs kept the plane well clear of Vietnamese airspace, making a sweeping entry into the Gulf of Thailand from the south, for a clear-weather arrival at Don Muang International.

But our duties weren't over yet; we were about to serve as diplomats. Despite having worked over 24 hours and enduring 100-plus degrees of tropical heat and and humidity, the navs and pilots conducted an elaborate tour of the aircraft for Thai VIPs, which included the Crown Prince, high-ranking generals and dignitaries, and 60 Thai Air Force cadets.

Since several of us could still utter a smattering of long-disused Thai words and phrases, that particular entourage became really impressed with the image of the machine and men propelling the aircraft from point A to point B.

The C-5 navigator is rapidly taking on new character. Besides keeping the missions on course, we are playing an ever-increasing role in keeping them safe, smooth and economical. We are the primary watchdogs of fuel conservation and avoiding waste. When we don't fly, many of us manage and lead in a variety of capacities—the 3 MAS Squadron Commander is a navigator!

When we do fly, we are probably in the best position of any C-5 crew member to ensure getting the job done right and safe in the tradition that has always made this navigator's Air Force number one in the world.

Capt Gilbert entered the Air Force via OTS in 1970. After completing UNT, he was assigned to the C-130 at Langley AFB. Next came duty in the AC-130 in Thailand and then Hurlburt Field. Capt Gilbert now serves as a Squadron Executive Officer at Dover AFB.

NAVSTAR II

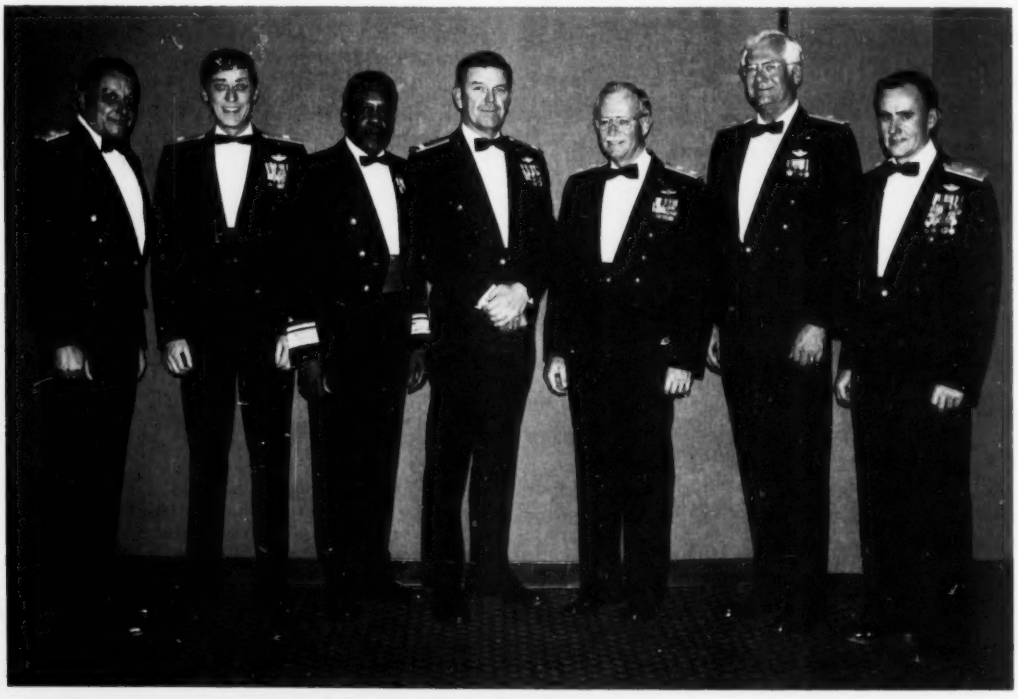
Mather Hosts the Generals

As Commander of the 323d Flying Training Wing and host of NAVSTAR II, I am very proud of Mather's annual tribute to our navigator generals. NAVSTAR is an important forum for bringing together our senior leaders and junior officers because it gives our people, especially the students and instructors, a chance to see and talk with successful role models. In addition, we're able to show the senior leadership just what we are doing at Mather and how we are doing it. Hopefully, NAVSTAR will become a long-standing tradition of the 323 FTW and the navigators who wear the stars.

Richard D. Paul

For the second year, the 323d Flying Training Wing, Mather AFB, California, commanded by Colonel Richard D. Paul, hosted NAVSTAR II. NAVSTAR is the title given the 323d's invitational Dining-In held to honor the United States Air Force's navigator generals. In addition to the Dining-In, the annual NAVSTAR event includes activities and functions designed to familiarize the general officers with recent changes in the navigator training program. Also, these activities enable Mather's junior officers to meet and exchange ideas with senior military leaders.

Six flag-rank officers attended NAVSTAR II, held 11-12 March 1982. Guest speaker for the Dining-In was Major General Irwin P. Graham,



The guests of honor with the NAVSTAR II host. Pictured are (from left): Brig Gen Pedroli, Brig Gen Tibbetts, RADM Hacker, Col Paul, Maj Gen Graham, Brig Gen Taylor, and Brig Gen Preston.

The guests of honor hear a pre-mission briefing.

Generals Graham (left) and Taylor (far right) are briefed on T-43A student console equipment by Capt Luke Lu.

Deputy Chief of Staff for Plans, Headquarters Pacific Air Forces, Hickam AFB, Hawaii. (See page 10 for an interview with General Graham.) Other honored guests included Rear Admiral Benjamin T. Hacker, Commander of the Military Enlistment Processing Command, Fort Sheridan, Illinois (the first Naval flag officer to attend NAVSTAR); Brigadier General Attilio Pedroli, Commander of the Defense General Supply Center, Defense Logistics Agency, Richmond, Virginia; Brigadier General Raymond C. Preston, Jr., Director of Program Integration, Office of the Deputy Chief of Staff for Research, Development and Acquisition, HQ USAF, Washington, D.C.; Brigadier General James Taylor (assumed Major General rank in May), Air Force Reserve Mobilization Augmentee to the Vice Commander, Headquarters Air Force Logistics Command, Wright Patterson AFB, Ohio; and Brigadier General Larry N. Tibbetts, Deputy Chief of Staff for Manpower and Personnel, Headquarters Air Force Logistics Command, Wright Patterson AFB, Ohio. Other special guests included business and civic leaders from the local community.

During their visit to Mather AFB, the guests of honor heard a comprehensive briefing on the 323d Flying Training Wing mission. To enhance their knowledge of various training simulators which support the Wing's mission, the officers toured the T-45 simulator complex and the Electronic Warfare and Navigator Bombardier simulators. A firsthand look at Mather's primary navigator training aircraft was provided when the guest officers flew an abbreviated mission aboard the Boeing T-43A. Wing instructor and student personnel had opportunities to listen to and question the generals in career forums held at the flying training squadrons.

Col Smith, 323 FTW/DO, greets Gen Graham (left) as the other officers deplane from the flight mission.

Maj Gen Graham shares his experiences with 449 FTS personnel.

Like the inaugural event in 1981, NAVSTAR II was an apparent smashing success. Aside from the Dining-In itself, the flag-rank officers immensely enjoyed their in-flight look at the T-43A. Student and instructor personnel were pleased with their opportunities to meet and talk with the generals and admiral.

The success of NAVSTAR has made it a greatly anticipated event that should continue to grow in size and stature with each year.

An interview with Major General Graham

In March, Major General Irwin P. Graham visited Mather AFB to attend NAVSTAR II. During that visit, the editor interviewed General Graham who is Deputy Chief of Staff for Plans, Headquarters Pacific Air Forces, Hickam AFB, Hawaii.

THE NAVIGATOR: Could you tell us a little about your days at Mather, and your subsequent flying assignments?

GENERAL GRAHAM: I went through Mather some 30 years ago, and at that time we had a variety of trainer aircraft—C-47s, B-25s and the then-new T-29. I flew most of my missions in the early versions of the T-29. We learned a lot, and most of us who didn't go to B-26s in Korea went to SAC and B-36s, or into MAC and C-118s, C-54s or C-124s. I was assigned to B-36s at Biggs AFB, Texas. That assignment to a new wing offered some unique challenges—among them the opportunity to join a lead crew a little quicker. We flew often in the B-36; I logged almost 1,000 hours the first year. That wasn't hard to do since we had rather long flights. My longest flight was from Guam to El Paso, nonstop, unrefueled, 32 hours, 35 minutes. SAC, then as now, was a very reliable, capable, and professional outfit, despite some of the problems with the old propeller engines. SAC moved quickly into the jet age, with the first B-52s acquired about three years after my graduation from Mather. My next assignment to B-57s was completely different—in many respects that airplane was more like a fighter than a bomber. Certainly, we could outdo most fighters in gunnery and bombing accuracy. The B-57 was a very simple airplane compared to the B-36, but its mission was both challenging and interesting. By the way, my B-57 squadron was quite an historic unit—the 8th Bomb Squadron. The 8th had been on continuous active duty since April 1917. It's been inactivated now for some eight years but, at the time of inactivation, it was the longest continuous active duty squadron in the US Air Force.

You mentioned that you served as a crew member until you were selected for colonel. How did your nav training and experience help you in your career, which has included many staff jobs?

Well, I have been associated with the planning aspect of the Air Force for some time. My experience indicates that rated officers, both pilot and navigator, have a full appreciation for the

application of air power to contingency operations. We know what we can do, as well as how to do it. When we begin to develop a contingency plan for a place we haven't been, we have a better idea of what to expect. From our experience with airplanes, we know what will be needed to do the job. Also, the mental discipline that navigation demands is a great help. My navigation experience has been valuable in exposing me to many Air Force leaders. Of the 350 or so generals in the Air Force today, I flew as a crew member with over 100 of them at various times in my career and have formed many lasting relationships.

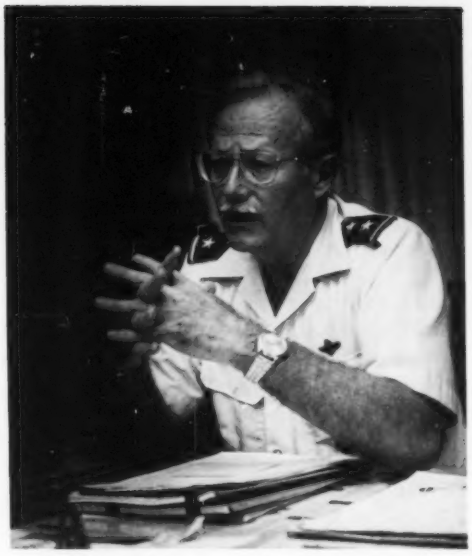
What about navigators commanding flying units?

Navigators can now command flying units, and this is a very welcome change. However, the opportunities for command, at least in the tactical forces, are diminishing as we change from the F-4 to the F-15, F-16 and A-10. Toward the end of the decade, however, things will be different, for we should be getting many two-seat fighters for the night, all-weather attack role. Right now it appears there will be a two-seat version of the F-15 or F-16. These will be fine systems to fly and very complex. Their mission will require the full attention of two crew members and the introduction of these aircraft will open new command opportunities for navigators.

How do you answer the comment that due to changing technology, the navigator is becoming obsolete?

Well, I thought I was going to be obsolete, too. And when I saw the ICBM come on board, I thought that pilots would be obsolete as well! Seriously though, I see a continuing need for navigators into the foreseeable future. Of course, the navigator's job will change, just as my duties as a navigator changed through the years. But, we will need navs in specialized mission fields, such as unconventional warfare. MPC projects a need of about 8,000 navigators well into the '90s. The mission changes and becomes more complex, but the need is still there. For example, in SAC, the B-1 will be coming on board with requirements for two navs on each crew.

Many people perceive a barrier for navigators in attaining general officer rank. Can you advise us on how the Air Force is reducing such barriers?



I believe the individual can control promotion potential. With the opportunity to command now available, you must make yourself the best officer possible to be competitive for command positions. You must look for a function in which you can excel, and many excellent opportunities exist apart from flying-command positions. Many navigators serving as base commanders, in senior positions, staff and so forth, are enjoying excellent careers with enormous potential for general officer rank. If general officer is your goal, the proper schooling is essential, both academic and PME, as well as career-broadening experiences. I have personally been involved with planning almost continuously since 1964. That does not suggest, however, that you should ignore or neglect your navigation. For my first five years in plans, I did a lot of flying. I augmented crews on C-54 and C-118s out of PACAF. When I went to Vietnam, I kept flying often, even though my job was in plans. I ran the war plans shop. Our task was to find more effective ways to fight the war. I flew 120 missions in 22 different types of airplanes, from 0-1s to B-52s, and participated in the full spectrum of tactical aviation. That is the type of diversification you must seek as you progress through the field grade ranks.

As the Air Force becomes more involved in the space program, what will the role of the navigator be?

The vast degree of engineering and high technology which goes into space missions presents terrific challenges for navigators. We will have navigators in space missions very

shortly. Space offers very demanding tasks for highly specialized engineers, navigators, and others who will plan and perform to meet those goals.

Could you give us some insight into the duties and responsibilities of your present job?

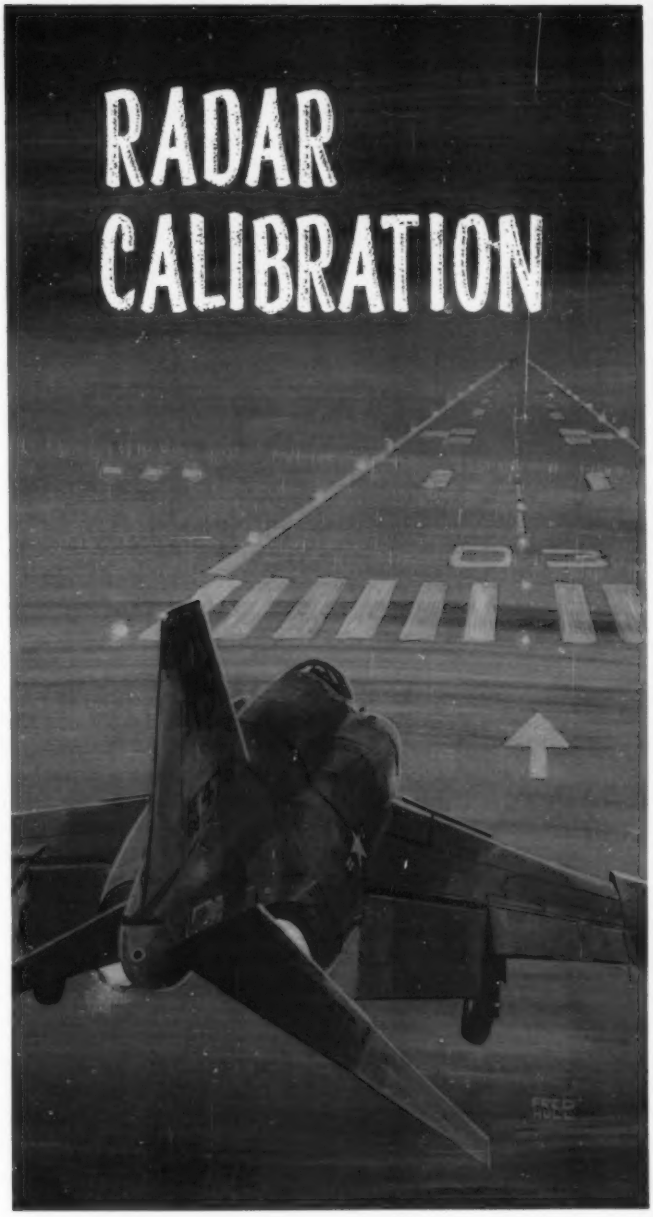
I am the planner at PACAF, with five directorates working for me. Incidentally, two of those five are headed by colonel navigators and my deputy is also a navigator. My contingency planners build war plans for limited and global conflicts. Our Programs Division determines how we allocate the airframes and the support structure we need to perform the mission. This is quite a task, for in PACAF we have been converting a number of F-4 squadrons to more modern aircraft—F-15s and F-16s. The Security Assistance Directorate works with other countries in determining the role of airpower in meeting security requirements. The Manpower and Organization Directorate provides the full range of manpower management services to all PACAF units—using its staff here and over 70 people dispersed to five locations (METs) in the WESTPAC. The fifth directorate, Policy, is responsible for doctrine and command relations. In addition, this directorate determines the 'prudent risk' force required to counter the present Soviet threat. Most recently, the emphasis of my work has focused on planning the Air Force budget submission. The Chief of Staff has sought increased participation from his field commanders in developing the budget with the Air Staff, and I frequently travel to Washington for budget discussions. This is critically important, and my boss, CINCPACAF, has made it my top priority.

Going back to career progression, were you promoted below the zone in your career and, if so, do you feel that it is vital for promotion to general rank?

I was promoted twice below the zone. I made major one year early and I made colonel one year early. I'm not sure what to attribute those promotions to because I was in an unusual job when I made major early. I was teaching school at the Naval Academy and I was the only Air Force instructor there. So, I had no one nuturing me or tracking the progress of my career. I attribute the promotion to the fact that I did the right things previously in SAC and then got a master's degree before going to the Academy to teach. Promotion to colonel is a little easier to explain. I went to ICAF, finishing as a distinguished graduate, and then went immediately to Vietnam. I had those experiences under my belt when the board met. I don't think below-the-zone promotion is essential for promotion to the rank of general officer, although it should be helpful. You simply have more time to acquire the rank, considering the mandate on when you must retire. Also, if promoted early, you are considered for the next grade ahead of your contemporaries. Consequently, you can spend more time as a general officer. I served eight years as a captain and eight years as a colonel, so it was my 27th year of officer service before I was promoted to general officer. I had some enlisted time before that. Even if I am selected for all the permanent ranks, I have a maximum of seven years to spend on active duty as a general officer. Still, many who are promoted right along with their contemporaries, what the personnel people call 'due course' officers, are going to make general, too.

Thank you very much for sharing your views and experiences with us. We look forward to meeting you again at NAVSTAR III in 1983.

RADAR CALIBRATION



Captain John C. SWEDA
455 FTS
Mather AFB, CA

"Nav, Pilot: I see some storm cells ahead. What are the tops on them?" Can you tell exactly where those tops are, or what altitude to request from center?"

You're on an ARA final to 03 left; the runway threshold finally breaks out at 5 nm, 4° to the right. How far are you displaced from runway centerline?

At critical moments like this, when your safety and that of your crew might be in jeopardy, it is important to get maximum information from the radar scope. To do so, here are two simple techniques you can add to your bag of tricks. The first is a simple conversion of the 1 in 60 rule—changing nautical miles to feet. The second technique, the "10° low" method, involves calibrating your radar tilt.

From the 1 in 60 rule, we know that 1° equals 1 nm at 60 nm. Therefore, at 30 nm, 1° equals 1/2 nm; at 20 nm, 1° equals 1/3 nm; and so forth.

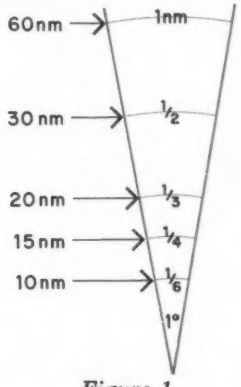


Figure 1

For those interested in formulas, we can write a ratio of:

$$x = \frac{\text{DEGREES OFFSET} \times \text{RANGE}}{60}$$

WHERE x IS DISPLACEMENT FROM DESIRED COURSE IN NAUTICAL MILES

In this formula, we convert nautical miles to feet by substituting 6080' for 1 nm, and, for simplicity, rounding this to 6000'. Our new formula now becomes 1° at 60 nm equals 6000. From the basic formula, we know that at 30 nm,

1° equals 1/2 nm, or 3000'. At 20 nm, 1° equals 1/3 of a nautical mile or 2000'. Looking for a pattern in this development, we find a simple relationship. By adding two zeros, our range becomes the number of feet which 1° equals at that range. Therefore, at 17 nm, 1° equals 1700'. This sounds interesting, but can we apply it? Let's try.

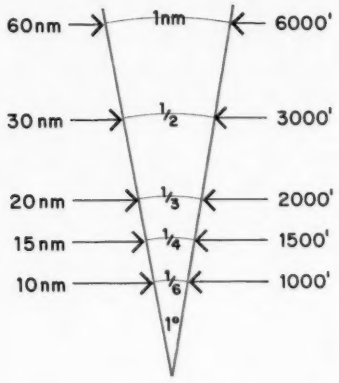
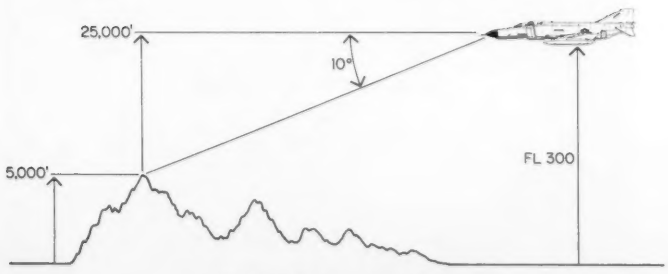


Figure 2

We're magically on an ARA final to runway 17. With the drift killed at 7 nm, we break out the runway threshold 6 degrees right of the nose. If we multiply 7 nm by 6° and add two zeros, we should get our displacement, or 4200'. We then notify the pilot that he's 4200' off course, and give him a heading. The same technique can be used for correcting line-up during low level or airdrops.

Note that the principle works in both the vertical and horizontal planes. This is important because it brings us to the next technique of finding radar level by calibrating the tilt control.

This technique, commonly used in fighters, is called the "10° low" method. However, it applies to all airborne radar sets because it can determine exactly where the radar tilt control should be set to adjust the radar antenna to level. Knowing that the radar is level enables us to tell if a mountain on approach is higher than our airplane, or whether we can climb over a storm cell.



The Ten Degree Low Method

For ease of illustration we will check our tilt calibration with a setting of 10° low. Relating back to our conversion of degrees to feet at given ranges, we know that, at 30 nm, 1 degree equals 3000 feet. Therefore, 10° in the vertical plane will equal 30,000 feet of altitude (3000' X 10 = 30,000'). Assuming that we are calibrating the tilt while flying level at 30,000 feet, we first set our tilt control at 10° low. Next, refine and narrow the radar energy pattern by switching the antenna to pencil beam. Select a target in front of the aircraft with good reflectivity, such as a mountain peak or island. By comparing the target altitude with our aircraft altitude, we can compute our absolute altitude clearance over the target. For example, if the target elevation was 5000 feet, then our target clearance would be 25,000 feet. By converting this target clearance to nm with the 1 in 60 rule we find the range at which we want to check the antenna tilt calibration is 25 nm. As the target approaches 25 nm on the scope, adjust the tilt until the surface return of that target is maximized with the target at exactly the computed range. Note the tilt control setting. If the antenna tilt is calibrated correctly, the setting should read 10° low. If it reads 8° low when the target passes 25 nm, then the control calibration is 2° in error (setting indicates 2° higher than actual) and a 2° correction is required for proper calibration. Knowing this, we can now read radar level by setting the tilt control at +2, or 2° high. Assured that we can then project radar energy exactly at our flight level or altitude, we can accurately judge when we will clear weather or obstructions and by how many feet.

By adding two zeros to our range, we can compute the number of feet which 1° equals at that range. By dropping the tilt to 10° low and checking calibration against a given target, we can find radar level. These are two simple techniques to place in your bag of tricks for that unanticipated situation in the future when it may take extra skill to safely complete the mission.

A 1974 Air Force Academy graduate, Capt Sweda completed UNT in 1975. He served in the C-141 at McChord AFB until 1977 when he was reassigned to Clark AB in the F-4E, followed by duty at Osan AB. Capt Sweda now serves at Mather AFB.

Education with Industry

Captain William C. EHLER
Propulsion SPO/YZD
Wright Patterson AFB, OH

In the flying business, career broadening and advancement are vital. With the increased need for rated officers in the cockpit, the opportunities to move into the supplement have become more competitive. If you have the ambition and are willing to put out that extra effort, however, an excellent opportunity awaits you—Education with Industry (EWI).

EWI, a 10-month management development program, will introduce you to one of 23 disciplines offered through AFIT. The largest percentage of positions are in the 65xx career field, of which I am now a member. To get my membership, I first earned a 6531 (entry level contracting AFSC) through the ADSAC program and applied for EWI while participating in ADSAC. (The application procedure can be found in the USAF Formal Schools Catalog, AFM 50-5 or through the EWI program manager 800-543-3577.) I then completed a new AF Form 90, expressing my interest in the program, and talked with the 65xx resource manager, (AUTOVON 487-3566) about the selection process and assignment possibilities.

Shortly after my selection I found out I was going to AVCO Lycoming, a turbine engine manufacturer in Stratford, Connecticut. The structure of the program permits us to work in any part of the company we feel will best fulfill our learning objectives. We can remain in these various areas for as long as we desire; however, the EWI program manager suggests that it's time to move on and learn something new when you become comfortable in an area. We actually become an integral part of the company and receive exposure to a civilian industrial environment unlike anything I've ever experienced and unlike any classroom courses.

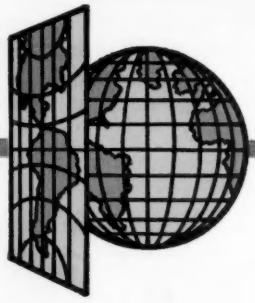
My particular program is geared to Quality Assurance and Manufacturing. Within this program, I've worked in Manufacturing Quality Control, the M-1 Tank Engine Program Office, and Purchasing and Material Control. It's quite interesting to see how the different organizations interact and depend on each other to get that finished product out the door. My new area will be the Industrial Productivity Improvement Office—the Army's version of our Tech Mod Program. The Army is investing funds in this plant to modernize the production floor through advanced technology and new machinery. Working in this area will be an invaluable experience, both for career development and my work at Wright-Patterson AFB.

My follow-on assignment will be to the Aeronautical Systems Division. The specific Special Program Office (SPO) has not yet been determined; however, I probably will work in the Propulsion SPO because of my AVCO background. That doesn't necessarily mean you will work in a job identical with your EWI company, but I'm certain you and the Air Force will benefit from the experience. Incidentally,

Systems Command is the largest user of the EWI 65xx graduates.

If you are interested in Education with Industry as an opportunity for career enhancement, start the application process NOW. Having met your flying gates and having a good record will help your chances because it's a very competitive selection process. Finally, don't sit back and let that next available assignment decide your future, get up and grab that once in a lifetime opportunity—EWI.

A graduate of Parks College in 1971, Capt Ehler was commissioned through OTS. After completing CCTS, he was assigned to Pease AFB. Next came duty at Seymour Johnson AFB, followed by AFIT. Capt Ehler presently is assigned to Wright Patterson AFB.



NAVIGRAMS

We are proud to present the navigator leaders recently selected for promotion to colonel. Congratulations and best wishes for continued success from THE NAVIGATOR.

Anduss, Larry P.
Arnold, Francis W.
Atchison, Richard M.
Baker, Ronald F.
Bauer, Richard H.
Bell, Jerald R.
Bell, Lawrence L.
Boergert, John R.
Brookie, James H.
Burch, Thomas E.
Burke, Billy E.
Butler, Walter O., Jr.
Chaloult, Michael P.
Chasteen, Calvin L.
Chittenden, Robert D.
Coen, James K., Jr.
Collins, William E.
Crook, Gordon R.
Crozier, Joseph A., Jr.
Davis, David C.
Dentremont, James A.
Devine, Bernard G.
Dillenbeck, Richard C.
Dishman, Benton G., Jr.
Dodd, Albert S. III
Donovan, Daniel J. II
Doyle, Edward T.
Driggers, Milton V.
Dumas, Charles J.
Emper, Neal H., Jr.
Faust, William M.
Ferrell, Oscar L.
Fritschie, Robert A.
Fuller, John T.
Gensheimer, James H.
George, Paul L.
Healy, Raymond V.
Henry, Larry L.
Holden, Raymond D.
Hoppmann, Frederick W., Jr.
Horney, James H.
Hubbard, Edward L.
Kane, Bernard E.
LaFrance, George A.
Lopez, Manuel, Jr.
Lovegren, Nelson L.
Malcom, Charles E.
Manini, Gary W.
Manolis, George
Marck, Ronald V.
McDonald, Martin J.
McGraw, Spencer D.
McPherson, Ronald L.
Melby, Carroll H.
Miller, James R.
Moorman, Frank T.
Morris, James P., Jr.
Morrison, Cameron E., Jr.
Mullen, Michael
Niebauer, David J.
Nolan, Gerald T.
Ohman, Nils B.
Percy, Donald G.
Perkins, Ernest R.
Peters, Lawrence W.
Phillips, William R.
Pimentel, Antonio T.
Reese, Thomas L.
Repasky, Frederick S.
Richards, James C.
Ryan, Robert L.
Schmidt, Walter K.
Seaton, Michael B.
Sebren, William E. III
Sheetz, Roy D.
Shinol, Henry E.
Singleton, Jerry E.
Siravo, Robert A.
Smetek, Ronald T.
Smith, Graham M.
Smith, Lester C.
Smith, Marcus C., Jr.
Spargur, Robert E.
Stewart, Laymon D.
Stripling, William D.
Sung, William K.
Svoboda, Ludvik Z.
Szachara, Walter S.
Tagaras, Michael T.
Touring, Ralph G.
Tonda, Harold K.
True, James L., Jr.
Turner, James R.
Tuttle, William C., Jr.
Verhees, Donald L.
Warn, Peter W.
Watson, Frank C.
Wehmhoner, Martin C., Jr.
Weil, Frederick W.
White, Richard W.
Wilhelm, John P.
Williams, Merle R., Jr.
Wood, Thomas W.
Wyatt, Ralph E.

NAVS OF NOTE

(continued from page 2)

LIEUTENANT COLONEL FREDERICK W. WEIL

Editor's Note: Just prior to press time, we were pleased to learn that Lt Col Weil has been selected for colonel. Our heartiest congratulations!

Lieutenant Colonel Frederick W. Weil is the Commander of the 343d Strategic Reconnaissance Squadron, Offutt AFB, Nebraska. "Raven Haven," as it is affectionately known, is a selectively manned unit flying SAC's RC-135 reconnaissance platforms. It is also the only unit in the Air Force that is manned entirely by Electronic Warfare Officers.

"It's a pleasure to return to a squadron where I was assigned as a lieutenant. Many young officers are now also afforded the same opportunity—direct assignment to the 343d from EW School. The operation of our various reconnaissance platforms needs dedicated EWs from all phases of flying expertise to accomplish our worldwide mission."

Colonel Weil entered the Air Force and navigator training in January 1962 through the Aviation Cadet program at James Connally AFB, Texas, where he received both his commission and wings. A "Crow from the word go," he was selected to attend Electronic Warfare School at Mather AFB, California. Upon its completion in 1963, he joined the 55th Strategic Reconnaissance Wing, then located at Forbes AFB, Kansas. There he flew the RB-47 until 1966, when the 55 SRW's move to Offutt AFB brought him into the Air Force's new RC-135 program. His RC career took him to the 82d Strategic Reconnaissance Squadron at Kadena AB, Okinawa, where he flew combat sorties during the Vietnam conflict.

A shift to staff officer duties found Colonel Weil serving in SAC's 15th Air Force at March AFB, California, as an Electronic Warfare Staff Officer, Reconnaissance Operations. A joint assignment at Nakhom Phanom RTAFB, Thailand, followed his 1973 promotion to major, where he served as a joint command staff officer with the United States Support Advisory Group.

"Staff experience is very valuable in building the future leaders of tomorrow. I encourage all young flyers to search out these opportunities when gate requirements permit."

Colonel Weil's versatility was challenged upon his return to the United States in 1975. He attended Chanute AFB's Maintenance Officers School and began a new phase in his career as Maintenance Supervisor in the 305th Field Maintenance Squadron at Grissom AFB, Indiana. In September 1976, he assumed command of the 305th Avionics Maintenance Squadron, followed in April 1978 by command of the 305th Field Maintenance Squadron. In late 1978, Colonel Weil was selected as Commandant of the SAC NCO Academy. His 1980 return to EW flying duties brought him full circle to the 55 SRW.

"The rated supplement drawdown will limit, but not eliminate, the requirement for rated officers to search out and master other skills. Navigators are needed to fill these vital positions throughout the entire spectrum. My experience in maintenance and training broadened my outlook on enlisted PME, OJT, and operational needs. Those five years were full and rewarding with constant reminders that everyone must work together to make the Air Force function at maximum potential."

An active proponent of PME and civilian education, Colonel Weil attended Squadron Officer School and Air Command and Staff College in residence and completed the Industrial College of the Armed Forces by correspondence, as well as earning a master's degree in Executive Development.

"Professional Military Education is an important step in any career plans you make. I feel young officers need to incorporate PME in their overall goals, and it's never too early to formulate these plans. We have career planning seminars in our squadron and bring guest speakers in from SAC headquarters and the Military Personnel Center to insure everyone understands their importance. Also, we have our own professional development seminars run by the crew members themselves, which build confidence in speaking and organizing. In addition, everyone gains from the specialized knowledge of our outstanding young officers."

Colonel Weil has over 4,000 hours of flying time, and has received the Distinguished Flying Cross with one Oak Leaf Cluster, the Air Medal with nine Oak Leaf Clusters, the Meritorious Service Medal with one Oak Leaf Cluster, and the Joint Services Commendation Medal.

"Flying, as we do today, is the most rewarding aspect of our job. We see the results of our efforts even before we land. Not many professions can claim this type of positive feedback. With constant state-of-the-art improvements, we hope to continue this positive trend. This flying builds a base for our EW officers that prepares them for a wide diversity of staff responsibilities. I am very proud to be back in the 343 SRS, a fine contingent of flying professionals."

Donald S. LOPEZ
National Air and Space Museum
Washington, DC

NIGHT FIGHTIN

Night fighting began in response to night bombing. In January 1915, German Zeppelins began night bombing attacks on England. The British tried to intercept them with fighters, but poor fighter performance and an almost total absence of detection equipment proved to be a great handicap. It was six months before the first Zeppelin was destroyed and that was by air-to-air bombing. By mid-1916, the combination of ground searchlights and higher performance fighters caused such great losses that Zeppelin raids were virtually abandoned, and the Germans began using Gotha and Giant bombers to attack England.

To combat the German bombing, the British set up a Home Defense Force using sound detectors, searchlights, ground observers, and trained pilots equipped with better aircraft. Diverting the British forces from the Western Front back to England was a primary goal of the German raids that backfired on the Germans. By prompting the British interest in air defense, the Germans helped the British defeat them in the Battle of Britain.

The British established a grid system of numbered and lettered squares covering southeast England. Raids were represented by markers moved along the grid table. The system was sound in concept, but it was fatally handicapped by the lack of ground-to-air communication.

The Germans, too, set up a rudimentary air-defense system using antiaircraft guns, searchlights, and trained pilots. The first night-fighter victory was in February 1917, when a German two-seater shot down two Allied bombers as they were landing after a raid, pre-staging the intruder tactics of the next world war. With more available targets, the German fighters had fairly good results, and at least one pilot scored five night victories.

The French also established a night-fighter force to combat the regular raids by the German Gotha bombers. A British night-fighter squadron based in France destroyed 21 German bombers during a four-month period late in 1918.

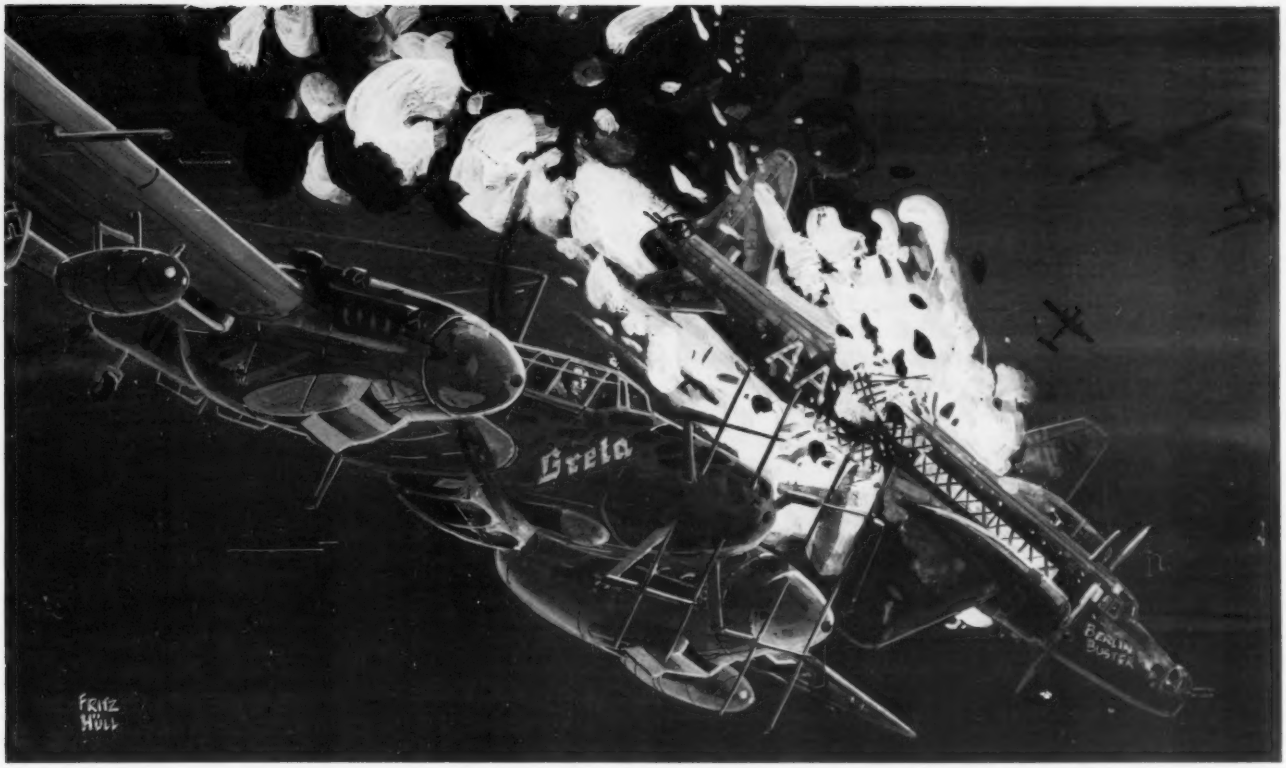
By the end of World War I, Germany, England, and France had all developed night-fighter systems as advanced as they could be considering the lack of reliable communications and good detection systems.

Not much was done to further develop the tools and techniques of night fighting until a few years before World War II. Germany, of course, was prohibited from developing an air force by the terms of the Treaty of Versailles. However, even when the Luftwaffe had come "out of the closet" in the early 1930s only cursory attention was given to night fighting; the Germans felt that their excellent flak (antiaircraft) guns were all that was needed to defend themselves against night bombing.

Between the World Wars, the "boffins," as the British call their scientists, had not been idle. By the beginning of the 1930s all of the required technology was available for the development of radar.

By 1936, the British had developed groundbased radar systems that could detect an aircraft more than 100 mi. away. A chain of these systems was set up as a warning and fighter control net for the defense of England. They were of relatively long wavelength and were accurate only to within several miles. (The lack of tight discrimination in the long wavelength radars can be compared to the difficulty of trying to pick up a needle while wearing boxing gloves. Shorter wavelengths give greater discrimination and accuracy.)

At about the same time, radar was being developed in Germany at the Freya and Wurzburg



Messerschmitt Bf 110G-4, equipped with Lichtenstein SN-2 radar, downing Wellington night bomber.

ground stations. The Freya system was an early-warning set and could not determine altitude; the Wurzburg system was used to control the flak guns.

The British realized that although their Ground Control Intercept (GCI) system was satisfactory for daylight operations, since targets normally could be seen visually for 5 mi or more, the GCI would be inadequate at night or in bad weather when the targets could not be seen for more than a few hundred yards. By mid-August 1937, the first airborne radar was flight tested. In 1939, the first practical Airborne Interception radar was tested in a Fairey Battle, and later that year, on the eve of World War II, 21 Bristol Blenheim long-range fighters were equipped with it. Throughout the War, the British continued to develop AI radar with shorter wavelengths, making it more accurate and effective.

Both the Luftwaffe and the Royal Air Force (RAF) used 2 or 3-man crews in their night fighters—a pilot, a radar operator, and sometimes a gunner. Usually a Luftwaffe night-fighter pilot received direction, speed, and altitude instructions by radio from the GCI station. In the latter stages of an interception, the pilot would be

G OVER EUROPE

guided by spoken instruction from the radar observer huddled over his AI set until the pilot could see the target at close range.

Neither the Germans nor the British developed aircraft specifically for night fighting but rather modified existing aircraft or those under development. Desired characteristics of a night fighter include good acceleration and deceleration to allow the pilot to synchronize his speed with that of the target, sufficient speed to overtake the target rapidly, heavy armament to destroy the target quickly, good visibility, and enough interior space to mount the radar equipment. In addition, long range and endurance were as highly desired then as they are today.

Germany's deadly 1943 Messerschmitt BF110G-4R2 with nose radar antennas and engine dampeners directed over the wings.

The Luftwaffe bombed England during The Blitz of 1940 almost at will, while the British night fighters and antiaircraft guns were virtually ineffective. The night fighters were radarless day fighters controlled by the Chain Home early-warning radar, which was not designed for controlling intercepts. The fighters could only be advised of the general location of the bombers. The interceptors were successful in only a few instances when the Moon was full or when the bombers were low enough to be illuminated by the searchlights.

The radar-equipped Beaufighters became operational in September 1940 and more were built in the following months. Improved AI radar sets were installed, and along with the British-developed GCI radar, they provided the guidance required for successful night fighter operations. (Inspection was still visual but was made much easier because the AI radar brought the fighter into close range.)

1945 Bristol Beaufighter, first successful British night fighter, featured radome and exhaust gas diffusers.

With this new combination, the effectiveness of night air defense increased markedly. The night fighters' (primarily the heavily armed Beaufighters') scores began to mount. In the first two months of the Blitz, the RAF night fighters shot down only eight bombers out of 12,000 enemy sorties. They shot down 22 in March 1941, 48 more in April, and 96 in the first two weeks of May. The Blitz ended that month because most of the German bombers were moved to Russia, although sporadic night raids continued throughout the war.

Most night combat in World War II occurred against the RAF night bombers during the Battle of Germany. It could be called the "Battle of Boffins" as each side evolved new techniques and equipment to gain advantage, usually temporary, over the other.

In July 1940, the Germans began to organize a night-fighter force. Before then, they had depended upon their excellent radar-directed flak. At first, radarless fighters were directed to the bombers by the Freya early-warning radar and by searchlights.

The Wurzburg flak-control radar was adapted for use as a GCI radar, but as its range was inadequate, a new model, the Giant Wurzburg, was developed. With this radar the Luftwaffe set up a defense system called Himmelbett (4-poster bed), dividing the airspace from Denmark across the north of Germany and France and down to Switzerland into about 750 boxes, each about 20

mi. wide. Each box contained a Freya early warning radar and two GCI radars. The GCI radars could also direct the searchlights in each box onto the target. This defense array was popularly known as the Kammhuber Line, after its organizer, Maj Gen Josef Kammhuber, Commander of Luftwaffe Night Fighters. The system was basically successful until 1942, when the RAF began large-scale raids that saturated the capabilities of the Himmelbett boxes. The Germans' Lichtenstein AI radar was introduced at about this time. Their efficiency in destroying RAF bombers markedly increased.

As the electronic war continued, the Germans developed both ground and airborne receivers that allowed them to track and home in on the emissions from the RAF H2S bombing radar carried in many of the heavy bombers.

To augment the Himmelbett, the Luftwaffe sent radarless single-engine fighters to the vicinity of target cities to spot bombers visually, both in the glow of the fires on the ground and in the beams of searchlights. This technique, called "Wild Sau" (Wild Boar), was quite successful during 1943. At that time, the RAF introduced Window, a method of jamming or spoofing the enemy radar by dropping foil strips cut to one-half the wavelength of the German radar. In the July 24, 1943, Hamburg raid, nearly 850 bombers released more than 92 million foil strips causing total confusion among the defenders. Only 12 bombers were lost, mostly due to Wild Sau fighters that were not affected by the Window.

Another RAF jamming method was the transmission of intense noise on the German night fighter/GCI voice frequencies. Without voice communication, the RAF bombers carried transmitters in the engine compartment, using the engine noise to drown out voice transmissions.

Also, the British used German-speaking airmen to broadcast false instructions to the night fighters. When the Germans switched to women broadcasters, the British promptly countered with German-speaking women.

The British sometimes added insult to injury by transmitting recordings of Hitler's speeches over the night-fighter control frequencies. Can you imagine trying to fly a fighter at night with one hand raised in the Nazi salute?

The Germans had developed a system of transmitting control information to the fighters by a teletype-like device, but the war ended before it became operational. Two other innovations did, however, aid them in bomber attack. Flensburg was a passive electronic device carried on the night fighters that received the signal from Monica, the RAF's tail-warning radar. Using Flensburg, the Luftwaffe fighters could locate and track bombers from more than 100 mi. away. The British did not discover this until a Flensburg-equipped Ju88 accidentally landed in England. The armament innovation was *Schrage musik* (slanted music), the cannon on the German night fighters that inclined upward at 60 to 70 degrees, allowing the fighter to remain below the bomber. In this position, the bomber was visible to the fighter, but the fighter was barely visible and out of the gun coverage of the bomber.

The Mosquito, used as a night intruder, helped by joining the British bomber streams to shoot down the German night fighters. The Mosquitos used both AI radar and Serrate, a passive receiver that could track signals from the German's Lichtenstein AI radar. By summer of 1944, the Mosquitos often outnumbered the German night fighters.

Despite all this, the German night fighter force remained a potent enemy, destroying more than 5,500 RAF bombers. In fact, in early 1944 the Luftwaffe night fighters came close to defeating the RAF Bomber Command. Because of excessive losses, the RAF abandoned their massive attacks on Berlin and other cities. The loss rate was greater than 5 percent—more than 1,000 bombers were lost—and more than 1,500 additional bombers were damaged. On the Nuremburg Raid on March 30, 1944, out of 795, the RAF lost 94 bombers with 71 damaged. The casualty rate in Bomber Command was the heaviest of any British service in the war. That the German night fighters were eventually defeated was due largely to the daylight attacks by the USAAF and by the shortage of fuel caused by round-the-clock bombing of Germany.

One of the positive outcomes of the war was the outstanding technological advances achieved. Through ingenious thought and innovativeness, radar systems grew and developed. But, although the war at night was largely a matter of technological measures and countermeasures, it was marked by the great skill and courage of the aircrews on both sides.

Courtesy Air and Space magazine,
Smithsonian Institution

Longitude by Visual Observation

Lieutenant Colonel John C. STAFFORD
144 TAS
Kulis ANGB, AK

Fifteenth century navigators were credited with telling time by the stars. Using this technique and a wristwatch, any navigator can visually determine longitude at night. Variations of this method can be used all over the world. However, longitude at night by visual observation has specific application to polar regions where the convergence of meridians reduces large errors in longitude to small position errors.

It was probably Mercator's teacher, Gemma Frisius, who first suggested in 1522 that longitude could be determined by comparing local noon with time on a clock brought from the point of departure. Although this technique has some inherent errors when using mean solar time, it can be used today with appropriate corrections. In 1522, however, Gemma Frisius' idea had come too soon, for an accurate clock would not be available for almost another 250 years.

Navigation techniques were developing very slowly and although day or night latitude was easily accomplished by various methods, no one could determine longitude. I will describe a few of the ingenious attempts at solving that problem and then show how to pull together two important past developments to form a new technique for determining longitude.

In 1522, Magellan's ship VICTORIA completed the first circumnavigation of the globe, and determining longitude became a practical necessity. Early attempts centered around building a better timepiece. For instance, in place of the Ampolleta—a half-hour glass—a 24-hour glass was suggested. Besides being impractical, it could not maintain accuracy for long trips. Later, several trips to the new world from Europe revealed that magnetic variation from true north changed rather predictably with longitude. However, further study showed that at different latitudes the same magnetic variation would occur at radically different longitudes and the method had to be abandoned.

With the invention of the telescope in 1608 and the founding of the Royal Observatory at Greenwich, England in 1675 came much more sophisticated techniques with fairly accurate results, particularly if observations were made on land. One of these methods, employed by Captain Cook on his ocean voyages, was to observe the eclipsing of one of the four visible moons of Jupiter and to note the local time—usually measured from midday. Captain Cook had a book of tables which listed the time in Greenwich for such an event and by comparing that time with the local time he computed longitude. Captain Cook knew the Earth rotated approximately 15° per hour, and the difference in time was easily converted to degrees of longitude east or west of the Royal Observatory.

Another method used by Captain Cook began by measuring the angle between the moon and the sun or a star. He would then compare those readings with a nautical almanac which showed the Greenwich time that particular angle would occur. Again, by comparing local time to Greenwich time, longitude was roughly calculated.

Incidentally, while English sailors were calculating their longitude from Greenwich, French sailors were measuring their longitude from an observatory in Paris. It was not until 1911 that all sailors measured longitude from Greenwich.

In 1761, John Harrison, an Englishman, finally solved the problem of determining longitude when he invented an accurate timepiece. It was first tested on a round trip from England to the West Indies. The trip lasted 147 days and the total watch error was only 1 minute 54½ seconds. On a subsequent 156-day round trip, the total watch

error was only 15 seconds! With a nautical almanac and an accurate timepiece set on Greenwich mean time, a navigator could now travel anywhere and determine his position with some certainty.

Longitude can be determined if local time—that is, time at the observer's meridian—can be compared to the time in Greenwich, England. John Harrison, and other watchmakers who followed him, enabled us to keep track of the time in Greenwich. To find local time by visual observation, we must borrow a technique used by Columbus roughly 30 years before Frisius and Magellan were making history.

On his first voyage to the new world, Columbus was able to tell the time at his meridian by looking at polar stars. With this ability, Columbus could make adjustments in the ship's time measured by an hour glass. With his knowledge of polar stars, he could also make corrections for latitude determined by Polaris which, at that time, was more than 3½° south of the celestial north pole.

Columbus was not alone in his ability to tell time by the stars. Many fifteenth century European navigators shared the knowledge that pole stars, such as Dubhe and Kochab, made one complete counterclockwise revolution around Polaris in slightly less than 24 hours. By knowing the position of Dubhe or Kochab in relation to Polaris at midnight, it was possible to tell time by imagining one of these stars as the hand of a giant 24-hour clock. We know that due to the Earth's rotation around the Sun, north polar stars will appear approximately one degree counterclockwise from their position at the same solar time as the day before. To account for this observed phenomenon, navigators of the past would memorize where Dubhe or Kochab would be at midnight with respect to Polaris, at two-week intervals throughout the year.

This isn't as farfetched or difficult as it may seem. With little more than the Air Almanac information, you can reconstruct on paper what these earlier navigators visualized in their head. Figure 1 shows how to tell time at the observer's meridian from the relative position of Dubhe to Polaris. A similar diagram can be constructed for Kochab or any other polar star visible from the observer's latitude. In Anchorage, Alaska, where I practice this technique, local time is based on the 150 W meridian which passes through the west edge of town. Therefore, I can check the accuracy of my visual observations by simply looking at local time on my watch.

Note, however, that if observations are taken either east or west of the meridian upon which the local time is based, the local time must be corrected based on the equations used by Captain Cook and others. They are: 1 hour = 15° of Longitude or, 1 minute = 15' of Longitude. Again, these equations are based on the rotation of the

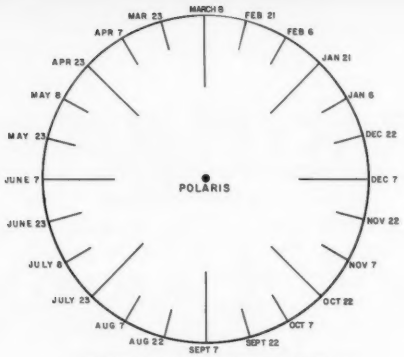


FIGURE 1a. DIAGRAM FOR TELLING TIME AT THE OBSERVER'S MERIDIAN FROM THE RELATIVE POSITION OF DUBHE TO POLARIS (1981). AT MIDNIGHT ON A GIVEN DATE, DUBHE WILL BE IN THE POSITION SHOWN. DUBHE WILL APPEAR TO MOVE COUNTERCLOCKWISE AT THE RATE OF 15° (ONE LINE) PER HOUR.

FIGURE 1b. DIAGRAM FOR TELLING TIME AT THE OBSERVER'S MERIDIAN FROM THE RELATIVE POSITION OF KOCHAB TO POLARIS (1981).

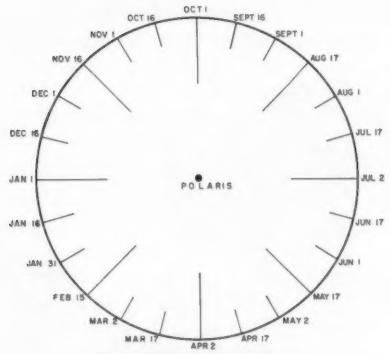


FIGURE 1c. DIAGRAM FOR TELLING TIME AT THE OBSERVER'S MERIDIAN FROM THE RELATIVE POSITION OF SHEDAR TO POLARIS (1981).

FIGURE 2. ORIENTATION OF NORTH POLAR STARS AT 2200 HOURS AT THE OBSERVER'S MERIDIAN ON MARCH 8.

Earth on its axis and are critical for all that follows.

Let's say it is March 8th and we observe Dubhe 30° clockwise from a position straight above Polaris (Figure 2). From Figure 1 we know the time at our meridian is 2200 hours. If the corresponding time in Greenwich is 0308 hours, our longitude is computed as follows:

0308 HRS (AT GREENWICH)
+2400 HRS
2708
-2200 HRS (AT OUR MERIDIAN)
508 HRS (LATER IN GREENWICH; THEREFORE, WE ARE WEST OF GREENWICH)

5 HRS x 15°/HR = 75°
8 MIN x 15'/MIN = 120' OR 2°
OBSERVERS LONG. = 77° WEST

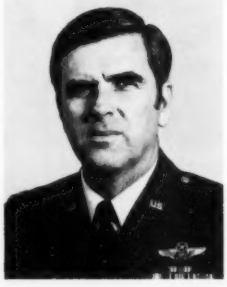
If the corresponding time in Greenwich was 1930 hours, the calculations would be:

2200 HRS (AT OUR MERIDIAN)
-1930 HRS (AT GREENWICH)
230 HRS (EARLIER IN GREENWICH; THEREFORE, WE ARE EAST OF GREENWICH)

2 HRS x 15°/HR = 30°
30 MIN x 15'/MIN = 7° 30'
OBSERVERS LONG. = 37° 30' E

I first tried this method on a flight from Anchorage, Alaska, over the north magnetic pole to Keflavik, Iceland. After making a few false starts, I quickly determined my longitude within 2 degrees with nothing more than a time hack and the unaided eye. With practice, that error in longitude can be reduced significantly.

Admittedly, longitude by visual observation will not replace our modern navigation methods. My personal experience proves, however, that it can make the dark polar regions of the world seem as familiar as your own back yard. In a modern era where we rely so heavily on gadgetry, what a comfort it is to merely look up into the night sky and quickly know where you are.



Lt Col Stafford completed UNT in 1961. After active duty assignments with the Air Weather Service and the Military Air Transport Service, he remained active in both ANG and AFRES flying units until the present. Lt Col Stafford currently serves as Commander, 144th Tactical Airlift Squadron, Alaska.

Rescue at Sea

Captain Donald K. MEYER
4951 TESTS/DOA
Wright Patterson AFB, OH

Sunday, December 14, 1980, was an unusual day on the remote island of Diego Garcia. Instead of the typical warm and sunny weather, the sky was cloudy with intermittent rain showers dampening the beach. The day was unusual also because it was the first Sunday that our crew had not been scheduled to fly since arriving three weeks before. As luck would have it, however, we were scheduled as the strip-alert crew, standing by for any emergency air refueling requests. Usually, strip alert means nothing more than having a flight suit ready and hanging on the end of your bunk—but not today.

Usually, strip-alert means nothing more than having a flight suit ready and hanging on the end of your bunk—but not today.

I remember the first call to our quarters because I was awaiting my turn to make a MARS call back home. The rest of the crew was fishing on a nearby dock when SAC Operations called to say that a Navy S-3 enroute to the tiny island was missing. The crew was directed to report to our aircraft for a possible launch. I quickly went to the dock to round up my other crew members and had little trouble finding them. Within five minutes we were back at the VOQ, donning our flight suits. During the short time I was gone, a second, more urgent request directed us to report to the flight line immediately.

Without knowing our destination or how long we would be gone, we jumped into the alert van for the drive to SAC Operations. There, we picked up a FLIP bag and communications kit and received our first briefing on the mission. A Navy S-3 was lost enroute to Diego Garcia. A MAC C-141 had established communications with the lost S-3 and directed the crew toward the isolated Indian Ocean island. Another S-3 launched from Diego Garcia to try and locate the distressed aircraft. The lost plane's last known position was believed to be 300 nm southwest of the island at an altitude of 30,000 feet. It should have been headed toward the island now but, with low fuel, its chances of safe arrival at the friendly runway were slim. With this information, we departed operations for the flight line. As we arrived at our tanker and began loading gear, we received orders to launch. The lost S-3 had declared emergency fuel. We raced through a quick preflight and started engines a little less than 50 minutes from the first call.

The aircraft parking ramp at Diego Garcia is at one end of the long runway. Every mission we had flown thus far required only a few quick turns out of parking to arrive at the hold line of the active runway. However, as bad luck would have

The normally short taxi seemed like an eternity. Each minute on the ground brought the S-3 that much closer to ditching.

it, the prevailing winds this day were opposite from the day before. We back-taxied the entire length of the 2 mile runway—a discouraging delay. The normally short taxi seemed like an eternity. Each minute on the ground brought the S-3 that much closer to ditching. Finally, the pilot pointed the tanker's nose down the runway, pushed up the throttles, and we were off. Safely airborne, we headed to intercept the 200 degree radial outbound and toward the S-3's last known position. We soon made radio contact with the rescue S-3 launched earlier from Diego Garcia. From conversation with its pilot, we decided that 10,000 feet would be the best search altitude due to scattered cloud layers in the operating area. We continued climbing to 10,000 feet and increased airspeed. Time was beginning to run out for the lost S-3. Our calculations indicated the plane had a little over 30 minutes of fuel remaining.

We desperately tried to get a few more knots of airspeed and turned on every exterior light to help the S-3 see us.

By the time we had reached 10,000 feet and accelerated to 450 KTAS, the rescue S-3 cleared the radio frequency to aid us in contacting the lost aircraft. Finally, we reached the pilot by radio and directed him to select air-to-air TACAN. When the TACAN locked-on, it indicated a range of 250 nm. Now it was a battle of distance versus time, with time having the upper hand. The pilot told us he had only 20 minutes of fuel remaining. We desperately tried to get a few more knots of airspeed and turned on every exterior light to help the S-3 see us. I cranked up every piece of rendezvous equipment. The air-to-air TACAN showed a steadily decreasing range. With no functioning radar on the lost S-3, we tried a DF steer. It was unsuccessful. Contact for refueling was up to both crews and the air-to-air TACAN which ultimately would decide the outcome. I knew then that the S-3 pilot was calling the shots for the rendezvous yet, in the back of my mind, I realized that he probably had little or no experience with our procedures. I remember thinking, "It's his life on the line, let him run the rendezvous his way." Now, less than 100 nm apart, time was growing short.

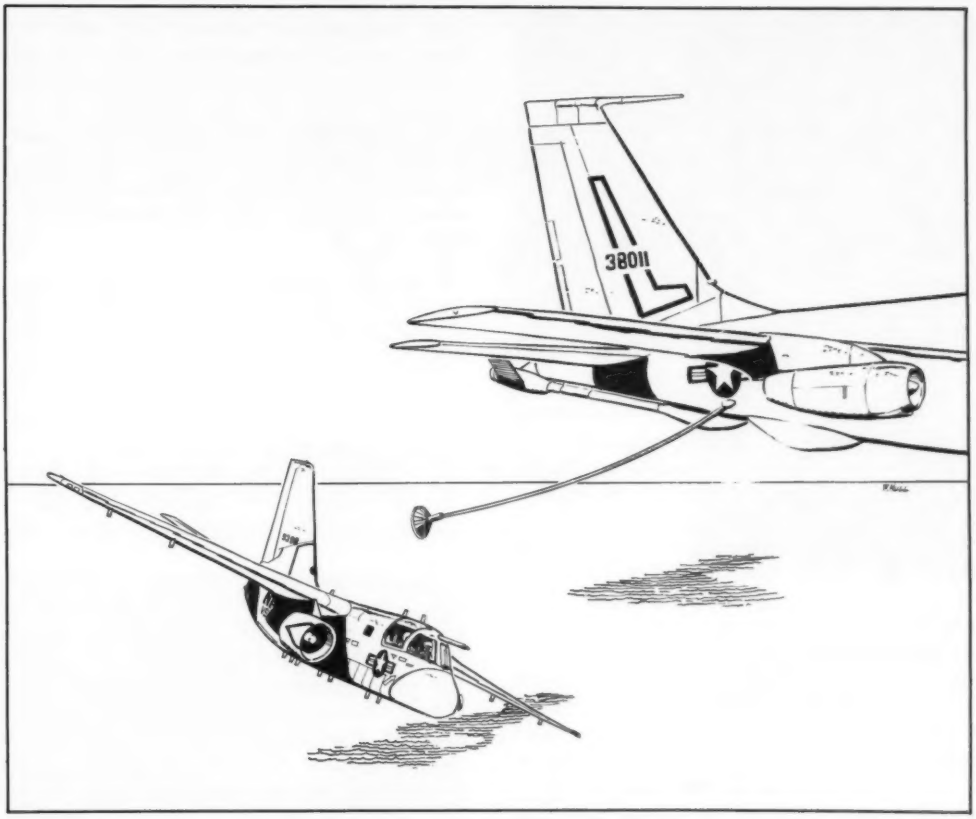
Maintaining 30,000 feet, the distressed S-3 began cross-checking the air-to-air range with

A sickening feeling came over all of us as we realized the two aircraft were passing each other in opposite directions...

DME from the Diego Garcia TACAN. Our plane was more than 100 nm from the island and unable to receive ground TACAN due to our low altitude. The S-3 pilot told us to turn in front of him at the 25 nm range. With his report of 10 minutes fuel remaining, he set idle power and started a descent to 10,000 feet. At 25 nm, we started a left turn while straining for a glimpse of the Navy aircraft. Then, we watched the air-to-air range stop decreasing and hold at 25 nm. A sickening feeling came over all of us as we realized the two aircraft were passing each other in opposite directions with 25 nm separation. At any time we expected to hear a ditching call from the S-3 crew. We knew there was no rescue helicopter available and a ship from Diego Garcia would take all night to reach the downed aircrew. Determined not to let these grim thoughts become reality, we told the S-3 pilot to perform 360 degree turns while we located his position relative to us. It was now a trial-and-error situation with very little margin for error. After heading 020 degrees, we turned south and the DME began increasing—wrong direction. We then turned northwest to 310 degrees and the DME held steady at 23 nm. Now the S-3 pilot reported that he was 130 nm from the Diego Garcia TACAN with less than five minutes of fuel. My navigation computer showed us 150 nm from the island. We immediately turned back to the north. The air-to-air range began a steady decrease and I felt a little better about the situation.

The air-to-air range began a steady decrease and I felt a little better about the situation.

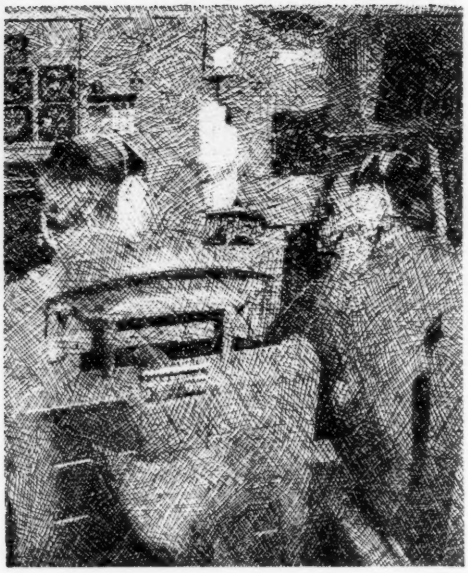
At about 7 nm air-to-air range the distressed S-3 sighted our aircraft and requested we make a slow left turn while he manuevered in behind us. We were finally together. Now it was up to the



boom operator and the S-3 pilot to complete the refueling. The pilot in the left seat of the S-3 had refueled from a KC-135 before but the right seater had never seen an Air Force tanker with a drogue installed. The hookup would either be steady as a rock or the S-3 would be all over the sky. Fortunately, the contact was steady and both crews breathed a sigh of relief. The S-3 pilot called each 1,000 lb increment as the life-saving fuel was pumped aboard his aircraft. After completing a 5,000 lb transfer, the S-3 asked to follow us on the short trip back to Diego Garcia. I looked out the window as the Navy plane pulled into formation and, for the first time in more than an hour, I relaxed. The rendezvous and refueling had taken a little more than 45 minutes. In that short time, we had insured that the S-3 crew would be able to tell their grandchildren about their close call over the Indian Ocean.

With the island of Diego Garcia in sight, we cleared the S-3 off our wing and obtained landing instructions. Five minutes later we were on the ground and meeting the crew that, only minutes before, had been just voices on the radio. A post-flight inspection showed that the boom system had developed a leak near the drogue connection, but that was a small price to pay for the safe return of four fliers and their aircraft. As we left the flight line for a well-earned meal, the sun was just setting. The satisfaction of that special day will remain etched in my mind forever.

Commissioned through OTS in 1974, Capt Meyer graduated from North Texas State University. After UNT in 1975, he was assigned to the KC-135 at Grissom AFB. He earned his master's degree in Public Administration in 1980. Capt Meyer presently is assigned to Wright Patterson AFB in the EC-135.



INSTRUCTOR DUTY AT MATHER

Captain Walter W. WOODRUFF
34 TCHTS
Little Rock AFB, AR

The term "career broadening assignment" is one we hear frequently in the military. Numerous Air Force jobs offer fliers the opportunity to expand their knowledge beyond the operational arena. One of the best for navigators is as an instructor in the Undergraduate Navigation Training (UNT) program at Mather AFB. Virtually every navigator is familiar with Mather, for it has been the only UNT base in the Air Force since 1965, and was the home of Navigator Bombardier Training (NBT) and Electronic Warfare Officer (EWO) training for years before that. The flying squadrons which support Mather training are the 450th, 451st, and 452d Flying Training Squadrons (FTS), the three Undergraduate Navigator Training organizations; the 449th FTS, Navigator Bombardier Training; the 453d FTS, Electronic Warfare Officer Training; the 454th FTS, T-43 Pilot Squadron; and the 455th FTS, T-37 Pilot and Navigator Training Squadron. This article will describe some of the specific jobs available to UNT instructors, the typical routine of an instructor, and the special opportunities available with Mather duty.

The requirements and application procedures for instructor duty at Mather are outlined in AFR 36-20. Basically, you need to have "instructor potential" and four years of retainability. Instructor potential does not mean that you must already be qualified to instruct in your current aircraft. A call or letter to your resource manager at MPC and a Form 90 can get the ball rolling. From there, it is surprisingly easy to find Mather orders in your hands.

The first stop for newly assigned instructors is Instructor Training School (ITS). ITS trains instructor navigators for the basic UNT program as well as NBT and EWO. The training is divided into three phases and the whole program, from first day of class to initial instructor qualification, takes about three months. The three phases are academic instruction (learning the art of platform instruction); 60-1 (basic qualification in the T-43A); and 60-2 (instructor qualification). During ITS, instructors assimilate a wealth of information in a relatively short time and, regardless of their backgrounds, find themselves learning the "UNT way." The 60-1 phase includes simulator missions in the T-45, and flights in the T-43. Most new instructor's initial impressions of the T-43A is that it is one of the cleanest, most comfortable Air Force aircraft. Configuration of the T-43A training compartment includes three primary training complexes, each consisting of four student training stations and one instructor station. Additionally, there are four other training-compartment stations with limited navigation

equipment. The T-43 trainer is equipped with very up-to-date and sophisticated navigational equipment including radar, inertial, Doppler, and a navigation computer system. Five sextants provide for celestial training. (Yes, even the fighter jocks get to polish their celestial skills.) For F-4 and F-111 types, it usually has been some time since the plotters, dividers, and sextant were used.

During academic training, new instructors learn the fundamentals of overhead and direct questions, time control, speech delivery, and other basics of platform instruction. Each trainee teaches two one-hour units of the UNT syllabus to actual students. Both one-hour blocks are evaluated and critiqued by an ITS instructor.

After academics, it's on to 60-1 with several T-43 flight missions and practice rides in the T-45 simulator. The requirements for 60-1 qualification are straightforward and simple. During the flight check, instructors demonstrate proficiency in radar fixing, celestial positioning, and logwork. ITS provides excellent training, with the success rate for initial 60-1 checks very high.

The 60-2 phase is next. In this phase, the new instructor really finds out what in-flight instructing is like. Several practice flights and simulator missions are performed, with the new instructor actually doing the teaching and evaluating. A good cross-section of training missions is flown including radar, day and night celestial, and low level in both the T-43A and T-45 simulator. A former Weapons Systems Operator (WSO) may find himself instructing four students on a day celestial flight mission, so study and preparation are essential. Most new instructors consider this phase the most enjoyable, since they see the whole UNT mission and have an opportunity to work with students at various experience levels.

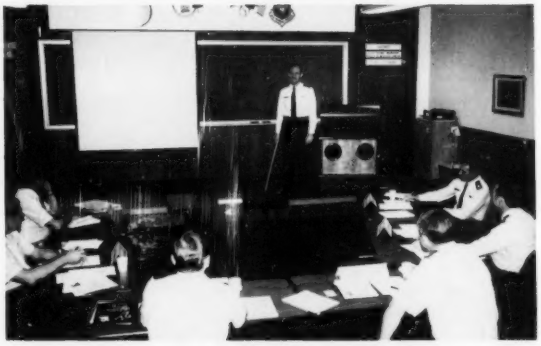
Normally, the 60-2 check ride follows six practice instruction rides in the T-43 and three T-45 simulator missions. A typical instructor check might be a night celestial mission, flying as I-2 (instructor in the second student complex) with four students. Again, preparation for this check is very thorough and evaluation results are usually excellent. After completion of the 60-2 phase, new instructors are qualified for T-43 missions and as ratios (helpers) in academics and the T-45 simulator.

Upon completion of ITS, the instructor joins one of the three UNT squadrons and is then assigned an academic speciality. Presently, the UNT curriculum consists of instructional blocks in Airmanship, Navigation Procedures, Basic Navigation, Day/Night Celestial, and Low Level. A new instructor will first complete follow-on training (FOT), which consists of monitoring an entire academic phase taught by an experienced instructor. FOT takes several weeks for most phases and lasts up to six weeks for Navigation Procedures.

Finally, the new instructor is qualified in an academic speciality and ready to teach on the platform. As one can see, the entire instructor training process is lengthy. Normally, about four months have elapsed from the time newly assigned instructors drive through the main gate until they are fully qualified and ready to teach academics.

As mentioned before, Mather instructors come from various backgrounds. Officers' previous assignments or types of aircraft can have little or no bearing on their UNT academic specialty or they can be an asset. Many Low Level instructors come from F-4s or F-111s, and relate their fighter experience directly to their academic areas. There are, however, many backseaters teaching Navigation Procedures or Day and Night Celestial. A former B-52 EWO might be selected to teach low level. Instructor specialization areas are determined by a combination of individual desires and squadron needs.

Within the 323d Flying Training Wing, job progression opportunities depend upon each individual's total time as a navigator, years of service, experience, abilities, initiative, and the needs of the wing. A junior captain (three to six years service) can expect to serve as a line instructor for about two years before consideration for other jobs. A senior captain will most likely serve as a line instructor before possibly moving to a flight commander's job or stepping up to Wing Stan/Eval. Field grade officers usually assume flight commander's slots or other staff positions fairly soon after earning their instructor qualification. These are not hard and fast rules, of course, and the best method of securing a higher-level job is to excel in the one you're first given.



The typical workload for a UNT instructor depends to some degree upon the assigned academic specialty. For example, when an instructor is teaching primary academics, such as Day Celestial, most time is spent in the classroom for the period of the academic instruction. When that celestial class moves to the simulation and flying phases, the primary instructor normally participates with the students. If the instructor is not teaching primary academics, time is spent flying or instructing in the T-45 simulator. The T-45, by the way, is a truly amazing trainer. It consists of 13 complexes, each with four student stations. Each complex can be programmed for a specific mission, and the four individual students within a complex can fly their own separate profiles of that mission. The student-instructor ratio is 2:1, providing ample opportunity for individual instruction. One of the nicest features of the simulator is that a student position can be "frozen," if necessary, while a problem is sorted out. Simulator missions are flown in the Basic Navigation, Celestial, and Low Level phases of UNT.

Five to six flights comprise a UNT squadron. Each flight usually has one instructor to teach each academic specialty. Typically, the instructors will spend about half of their duty time teaching academics. This can vary, of course. Sometimes an instructor will teach two academic phases back-to-back. Student training may start as early as 0500, with the normal workday 8-10 hours long. Flying duty days may be longer.

As mentioned before, staff positions are available at both squadron and wing levels. In fact, Mather can be thought of as being run "by navigators, for navigators." The wing jobs available run the gamut from plans, operations, and scheduling to training and curriculum. Stan/Eval is ever present, of course, and the division offers several openings per year. By the way, one of the choice wing-staff jobs is as the Editor of the magazine you are holding in your hands!

A job at Mather can be exciting, rewarding, and extremely challenging. Opportunities for off-duty activities abound. The production of navigators is scheduled to increase over the next few years. A Mather assignment will definitely expand your professional knowledge and broaden your horizons, while affording you a chance to join one of the finest organizations in the Air Force.

Capt Woodruff graduated from North Carolina State in 1972 with a degree in Aerospace Engineering. After completing UNT in 1973, he served in the C-130 at Little Rock AFB until 1978 when he was reassigned to Mather AFB. From May 1980 until May 1982, Capt Woodruff was Editor of THE NAVIGATOR magazine. He is now a C-130 academic instructor at Little Rock AFB.

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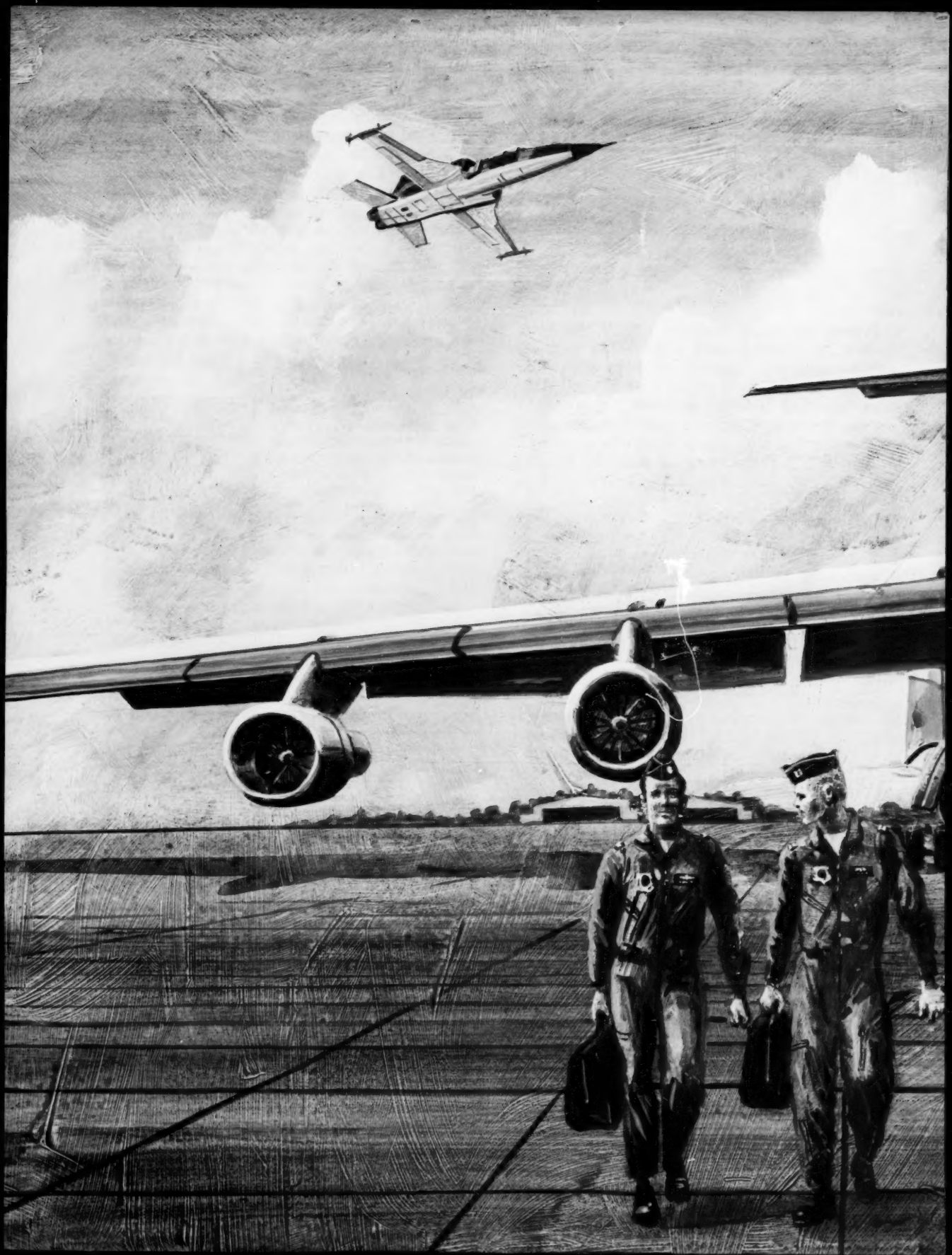
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